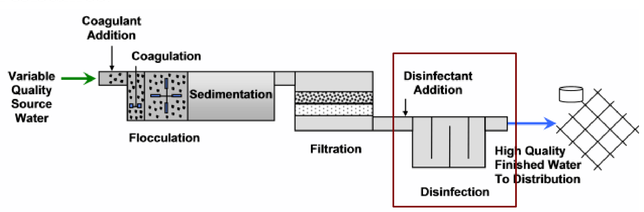
Does the Disinfection of Public Water Supplies Increase Antibiotic Resistance Levels?

Emma J. O'Leary and Timothy M. LaPara
Department of Civil, Environmental, and Geo- Engineering
500 Pillsbury Dr SE, Minneapolis, MN 55455-0116

I. Background

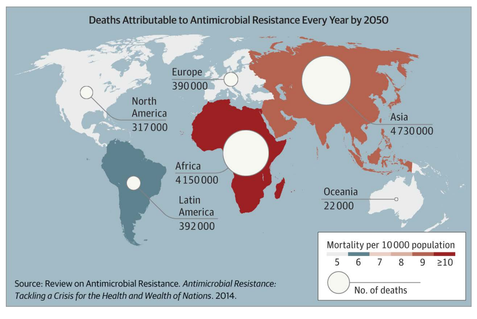
The wide-spread disinfection of public drinking water supplies is one of the greatest achievements of the 20th century. Modern drinking water treatment technologies, however, are now sufficiently effective such that the need for the continued disinfections of drinking water supplies has been questioned. Drinking water disinfection, for example, is known to produce small quantities of chlorinated organic compounds as disinfection byproducts, which are known to cause cancer. More recently, researchers have also suggested that drinking water disinfection increased the quantity of **antibiotic resistance**.



II. Objectives

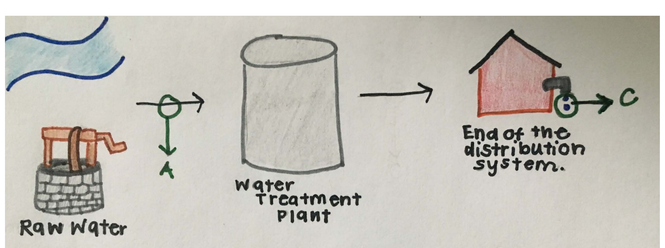
Determine if disinfection correlates with antibiotic resistance genes in drinking water supplies by:

1. Sampling from municipalities that use different types of disinfectant: none, chlorine, chloramine
2. Sampling pre-treated water (before entering the treatment facility) and water from the distribution system (at the tap)
3. Targeting specific genes that have been known to cause antibiotic resistance



III. Materials and Methods

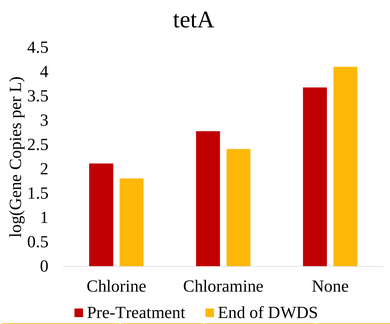
Sites were chosen based on disinfection type: chlorine, chloramine and no disinfectant. Samples were taken from before treatment (point A) and at the tap (point C). Approximately 6000-8000 L were filtered through a hemodialysis membrane (shown to the left). The membrane was back-flushed and processed leaving a concentrated microbe and water solution, typically between 1-4 mL.



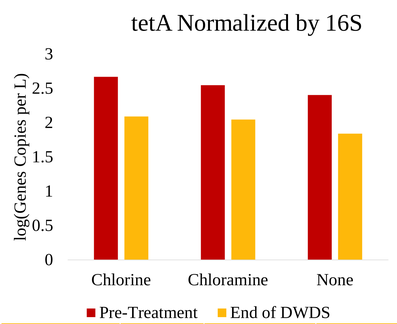
Targeted Genes so Far	Parameter Measured
tetA	Antibiotic Resistance
intI1	Antibiotic Resistance
16S	Total Microbial Analysis

The DNA was then extracted from the concentrated sample, resulting in 10 µL of concentrated DNA . qPCR was done on the extracted DNA targeting specific genes known to cause antibiotic resistance using EvaGreen Master Mix.

IV. Results to Date



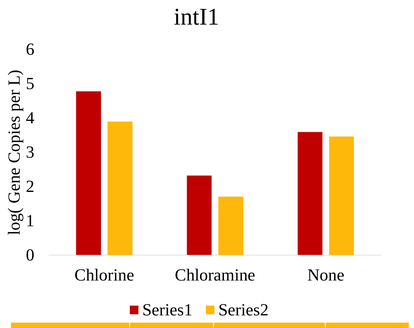
	Chlorine	Chloramine	None
Standard Deviation at A	1.10	0.909	1.39
Standard Deviation at C	0.983	0.673	0.497



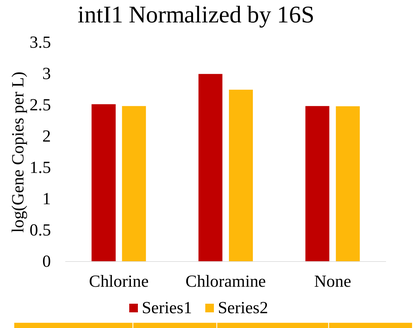
	Chlorine	Chloramine	None
Standard Deviation at A	1.06	0.378	1.15
Standard Deviation at C	0.960	0.771	0.415

Hypothesis Tests tetA

Hypothesis	P value	Result
Before Disinfection > After Disinfection	0.049	Disinfection led to a statistically significant decrease in tetA.
After Disinfection > Before Disinfection	0.004	Disinfection led to a statistically significant increase in the ratio of tetA to 16S.



	Chlorine	Chloramine	None
Standard Deviation at A	1.21	0.555	0.199
Standard Deviation at C	0.912	0.948	0.288



	Chlorine	Chloramine	None
Standard Deviation at A	0.737	0.285	0.380
Standard Deviation at C	0.696	0.436	0.441

Hypothesis Tests intI1

Hypothesis	P value	Result
Before Disinfection > After Disinfection	0.0001	Disinfection led to a statistically significant decrease in intI1.
Before Disinfection ~ After Disinfection	0.61	Disinfection did not change the ratio of intI1 to 16S.

Acknowledgements

- This study would not have been possible without the willing participation of the cities and without the assistance of graduate student John Galt of the LaPara Research Group.

V. Summary

- For both tetA and intI1 the number of gene copies per L decreased through disinfection.
- On average, for both tetA and intI1, the number of gene copies did not change in the DWDS with no disinfection.
- Disinfection leads to a statistically significant decrease in intI1 and tetA gene copies per L.

VI. Future Work

- Droplet Digital PCR will be conducted on the following genes: bla_{SHV}, intI1, intI2, intI3, mexB, qacF, strB, sul1, sul2, sul3, tetA, and tetX
- Results will be further analyzed to determine if there is a positive correlation between disinfection and antibiotic resistance.